AMENDMENTS TO THE SPECIFICATION:

Please replace the title of the invention with the following rewritten title:

AN OPTICAL INFORMATION RECORDING AND REPRODUCING APPARATUS FOR RECORDING INFORMATION BITS INTO AN OPTICAL DISK IN A THREE DIMENSIONAL ARRANGEMENT

Please replace the paragraph beginning page 1, line 11, with the following rewritten paragraph:

A conventional optical information recording/reproducing apparatus which records information bits in a three-dimensional arrangement is disclosed in Japanese Patent Laid-Open Publication No. 6-28672. The conventional optical information recording/reproducing apparatus is shown in Fig. 8. In the information recording method employed in this apparatus, a light beam 102 emitted from a light source 101 is incident to an information recording medium 111 formed of a material of a member ("a recording member") to be recorded with information bits, such as a photopolymer, having a thickness larger than the wavelength of the light beam by means of an objective lens 114 (a converging light beam 107), and thus a converging point is recorded as an information bit 105. The information bit results from a change in the refractive index or the like, and the size of which is generally larger than the wavelength of the light beam in any of the x, y and z directions.

Please replace the paragraph beginning page 2, line 4, with the following rewritten paragraph:

Furthermore, it is possible to reproduce a signal by converging a light beam with low power on this information bit 105 ~~similarly~~ and detecting the converging light beam 107 at a light detector 110 via the objective lens 114 and a beam splitter 113. In order to increase the information capacity, as shown in the same drawing, information bits 105 are recorded in the

information recording medium 111 in a three-dimensional arrangement in the direction of the optical axis (z direction) of the objective lens 114.

Please replace the paragraph beginning page 3, line 6, with the following rewritten paragraph:

The present invention is directed to solve the aforementioned problems in the prior art, and has a purpose to provide an optical information recording and reproducing apparatus for recording information bits in a three-dimensional arrangement, and particularly to an optical information recording and reproducing apparatus capable of recording information bits in good condition.

Please replace the paragraph beginning page 4, line 18, with the following rewritten paragraph:

Furthermore, the apparatus may comprise a focus/track error signal detecting optical element which is an optical splitting element and disposed in an optical path including the objective lens and the light detector, and a pinhole array having a plurality of pinholespin holes and disposed in the optical path. In this case, the light beam from the information recording medium is split into a plurality of light beams by means of the focus/track error signal detecting optical element, and the plurality of light beams are detected by the light detector after passing through corresponding pinholes of the pinhole array.

Please replace the paragraph beginning page 5, line 12, with the following rewritten paragraph:

Furthermore, the apparatus may further comprise a focus/track error signal detecting optical element disposed in an optical path including the objective lens and the light detector, and a pinhole array having a plurality ofplural pinholes and disposed on the optical path. In this case, the light beam from the information recording medium is split into a plurality of light beams by means of the focus/track error signal detecting optical element, and the light beams

corresponding to track error signals are detected by the light detector after passing through pinholes of the pinhole array.

Please replace the paragraph beginning page 6, line 12, with the following rewritten paragraph:

The information recording medium may comprise~~comprises~~ only a single recording member. Alternately, the information recording medium may comprise a recording member and a substrate. Alternately, the information recording medium may be configured by a recording member sandwiched between a substrate and a protecting member.

Please replace the paragraph beginning page 7, line 23, with the following rewritten paragraph:

Fig. 1 is a side view showing a basic configuration of an optical head of an optical information recording and reproducing apparatus (recording/reproducing apparatus) in the first embodiment of the present invention, in which a light transmission path is also shown.

Please replace the paragraph beginning page 8, line 25, with the following rewritten paragraph:

Fig. 7 is a side view showing a basic configuration of an optical head of an optical information recording/reproducing apparatus in the third embodiment of the present invention, in which a light transmission path is also shown.

Please replace the paragraph beginning page 9, line 15, with the following rewritten paragraph:

Fig. 1 is a side view showing a basic configuration of an optical head of an optical information recording/reproducing apparatus in the first embodiment of the present invention, in which a light transmission path is also shown. Fig. 2 is a diagram showing a manner of recording a signal on an information recording medium by the recording/reproducing apparatus

of this embodiment. Figs. 3A to 3C and 4A to 4D are diagrams of light beam trace for various magnitudes of refractive index of information bit to be recorded on the information recording medium by the recording/reproducing apparatus of this embodiment. Fig. 5 is a diagram showing a manner of recording a signal on an information recording medium with another configuration by the recording/reproducing apparatus of this embodiment.

Please replace the paragraph beginning page 12, line 18, with the following rewritten paragraph:

The pinhole array 14 is located so that the pinholes are positioned at approximately focus points of the split light beams 17a to 17c~~17~~, however separate pinholes may be located in the positions corresponding to the focus points of the blanched light beams 17a to 17c~~17~~. By making the sizes of the pinholes smaller than the respective converging light beams 17a to 17c~~17~~, only the light in the center of each converging light beam 17a to 17c~~17~~ can be detected. Thus, it is possible to remove unnecessary high-order aberration light distributed in the vicinity of the blanched light beams 17a to 17c~~beam 17~~ and to improve not only the S/N of a reproduction signal but also the S/N of an error signal of the servo control. Although in this case the amount of light decreases as a result of deleting the light in the periphery of the blanched light beams 17a to 17c~~beam 17~~, using an APD (avalanche photodiode) can increase the signal intensity. With regard to an apparatus for recording/reproducing bit information in a three-dimensional arrangement, use of the APD is effective since the amount of detected light cannot be so large because of the limitation in material.

Please replace the paragraph beginning page 13, line 13, with the following rewritten paragraph:

Furthermore, the same effect can be obtained when the aforementioned split light beams 17a to 17c~~17~~ are detected by the light detectors 10a to 10c~~10~~ with smaller areas than the respective split light beams 17a to 17c~~17~~ in place of the pinhole array 14. Furthermore, only the split light beams 17b and 17c corresponding to a track error signal may be passed through the

pinholes 14b and 14c of the pinhole array 14 so as to be detected by the light detectors 10b and 10c, while the split light beam 17a corresponding to a focus error signal may be directly detected by, for example, the optical detector 10a having four divided parts, without passing through the pinhole. With such an arrangement, an astigmatism method, for example, can be used as a method for detecting a focus. Furthermore, in this case, making the area of the light detector 10a smaller than the cross section area of the split light beam 17a at the detection point allows high-order aberration to be reduced.

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Please replace the paragraph beginning page 14, line 5, with the following rewritten paragraph:

In the present embodiment, the objective lens 4 is configured by a pair of lenses~~two lens~~ 4a and 4b, and has a high numerical aperture NA more than 0.7 (for example, 0.85). The high numerical aperture is advantageous to improving recording density on the plane (xy-plane) and reducing an interval of bits 5 in z direction to increase recording density. Furthermore, as the information recording medium 11, a substrate 11a having a thickness, e.g., of 600 μm is used in combination with a recording member 11b having a thickness which is larger than the wavelength, e.g. several tens to several hundreds μm. Though the substrate is formed, e.g. of polycarbonate, resins such as PMMA, glass and the like are also useful. Furthermore, as the recording member 11b, those having optical constants such as refractive index which vary in accordance with the light intensity are used. For example, photo refractive crystals such as photopolymers, organic pigments and LiNbO3, multiphoton absorbing materials such as heavy chromic gelatin and diallylethene, and the like are useful. In the present embodiment, for example, a photopolymer is used of which refractive index rises in response to light irradiation[[,]].

Please replace the paragraph beginning page 15, line 14, with the following rewritten paragraph:

As shown in Fig. 2, by irradiating the recording member 11b of the information recording medium 11 with the converging light beam 7, the refractive index of the focal point increases, thereby an information bit 5 is recorded (in Fig. 2, only already-recorded information bits are represented by gray circles). In the present embodiment, however, the converging light beam 7 of the objective lens 4 records sequentially information bits in a three-dimensional arrangement in the recording member 11b such that the converging light beam 7 does~~do~~ not pass through the already-recorded information bits.

Please replace the paragraph beginning page 18, line 4, with the following rewritten paragraph:

As described above, the inventors of the present invention have found that, by recording sequentially the information bits into the recording member 11b in a three-dimensional arrangement in such an order that the converging light beam 7 of the objective lens 4 does not pass through the already-recorded information bits, the phenomenon of defocus does not occur and an excellent recording can be obtained. The inventors also have found that the defocus in the recording is within an~~a~~ allowable range under conditions in which the change amount Δn in refractive index of the refracting sphere 5 representing an information bit is less than or equal to 0.02 and in which the information bits are sequentially recorded into the recording member 11b in a three-dimensional arrangement such that the number of rows of information bits which have been already recorded and through which the converging light beam 7 from the objective lens 4 passes is not more than 4 in the direction of optical axis (z direction). This can be explained by the fact that, at Δn=0.02 in Fig. 4A, the light beam at the focus point does not pass through the neighboring refracting spheres.

Please replace the paragraph beginning page 19, line 17, with the following rewritten paragraph:

In the optical information recording/reproducing apparatus of the present embodiment, wavelength λ emitted from the light source substantially satisfies a range $0.35\mu m = \lambda = 0.45\mu m$,

and the optical system including the objective lens 4 is configured to be achromatic. In particular, since the dispersion of materials of the optical system tends to be large in the wavelength range, the achromatic configuration can provide desirable optical characteristics. In the present embodiment, the objective lens 4 has an achromatic configuration including a set of three lenses 4a to 4c which are convex, concave and convex lenses. However, the achromatic configuration may be realized by the collimator lens consisting of a set of two convex and concave lenses or a set of three convex, concave and convex lenses, or by another other optical system. Furthermore, the information recording medium 11 consists only of the recording member 11b, thereby providing an advantage in a cost because of the simple structure.